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THE

INDIAN FORESTER.

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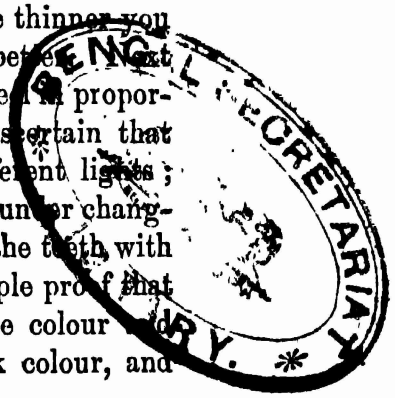
NOTES ON THE UTILIZATION OF FORESTS.

(*Continued from page 300*).

How to select saws.—A few general directions will prove useful. First of all try the blade by springing it; it should be elastic, and stiff enough without being too thick. The thinner you can get a stiff saw the better; also the narrower the better. Next see that it bends regularly and evenly from point to heel in proportion to its width at each place. In the third place, ascertain that the blade is ground smooth by examining it in different lights; the appearance of the surface should remain the same under changing lights. Then test the temper by bending one of the teeth with a sharp blow; if the tooth does not break, there is ample proof that the teeth will not break in use. Lastly, examine the colour and ring. The blade should by preference be of a dark colour, and when struck, should give a clear bell-like sound.



If the saw is a one-hand one, it should be well balanced when held in the position for cutting. Moreover, the handle should be made of strong, well-seasoned wood, should fit the hand properly, and should be firmly attached to the blade.

How to measure up sawing work.—A few words on this point are necessary, as it is not uncommon to read, even in printed official reports, of the amount of sawing done estimated in so many cubic feet! The work done by a saw is evidently the area of surface it has cut through—not the sum of the two surfaces, one on each side of the kerf, but the single surface, supposing the kerf to be a mathematical plane.

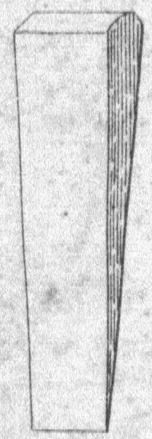
Nevertheless, in paying up sawyers, since slabs and other pieces flitched off, although they are taken off by the saw, are not deemed

to be sawn goods, it is customary to measure up the *total* surface of what comes under this designation. As a certain considerable amount of detailed measurement and calculation are necessary to get at this figure, a still simpler plan is pursued when a large quantity of goods of a single fixed scantling is prepared : the work to be paid for is ascertained in running feet. The simplest case of all would of course occur when the sawing was paid for by the *number* of pieces in each class of goods turned out. But none of these methods of measuring up work gives the real amount of sawing work done.

Article 4.—Wedges.

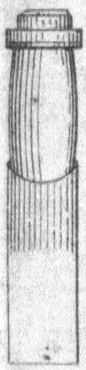
Wedges may be made entirely of iron (*Fig.* 40), or of wood and iron combined (*Fig.* 41), or of wood alone (*Fig.* 42).

Fig. 40.



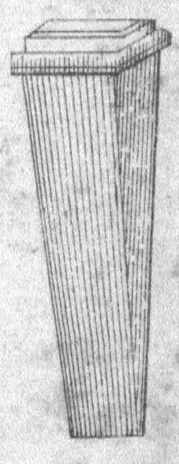
Iron wedge.

Fig. 41.



Chisel-wedge.

Fig. 42.



Wooden wedge.

Iron wedges are unnecessarily heavy and costly, and are therefore seldom used. They require to be driven with heavy wooden mallets.

The second class of wedges (*Fig.* 41) is very much more serviceable ; perhaps the most serviceable of the three. It is on the same principle as the ordinary Indian village chisel, the head, corresponding to the handle of the chisel, being of some hard, compact wood, strengthened with an iron ring round the crown. Both this and the next class of wedges are driven with the back of a heavy axe.

Wedges of the third class (*Fig.* 42) are shaped out of some hard

tough wood, the grain running with the length of the wedge. In conifer forests they are readily made out of the branchwood. If the wedges are carefully made from wood not immediately at hand, the head may be protected from splitting with an iron ring.

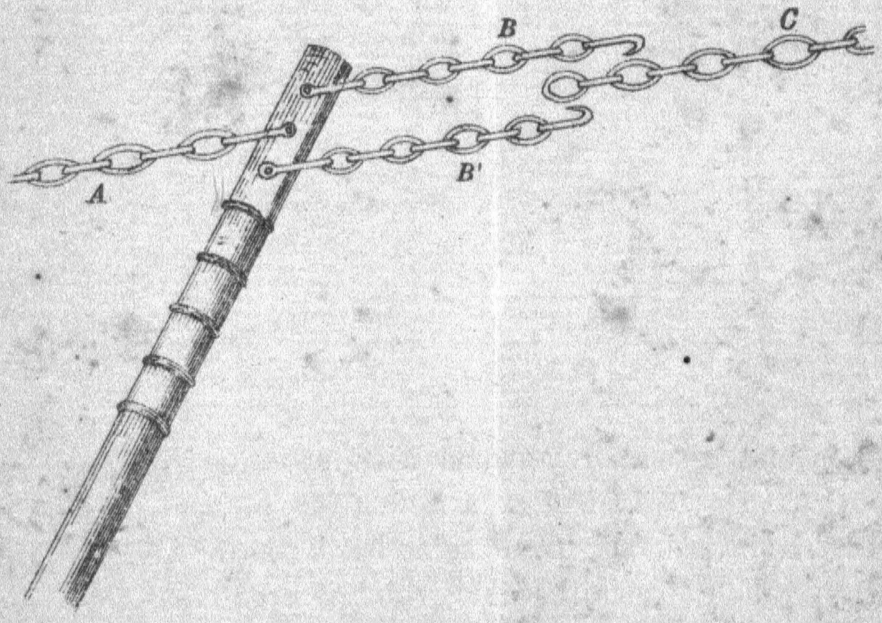
Article 5.—Tools for directing the fall of trees.

These are strong chains ending at either extremity in a hook attachable to any of the links, the *forest devil*, and an apparatus which may be termed the *thrust pole*.

The chains are used for hauling down trees in a given direction when they have been sufficiently cut through.

The forest devil (*Fig.* 43) consists of a strong pole about 6 feet

Fig. 43.



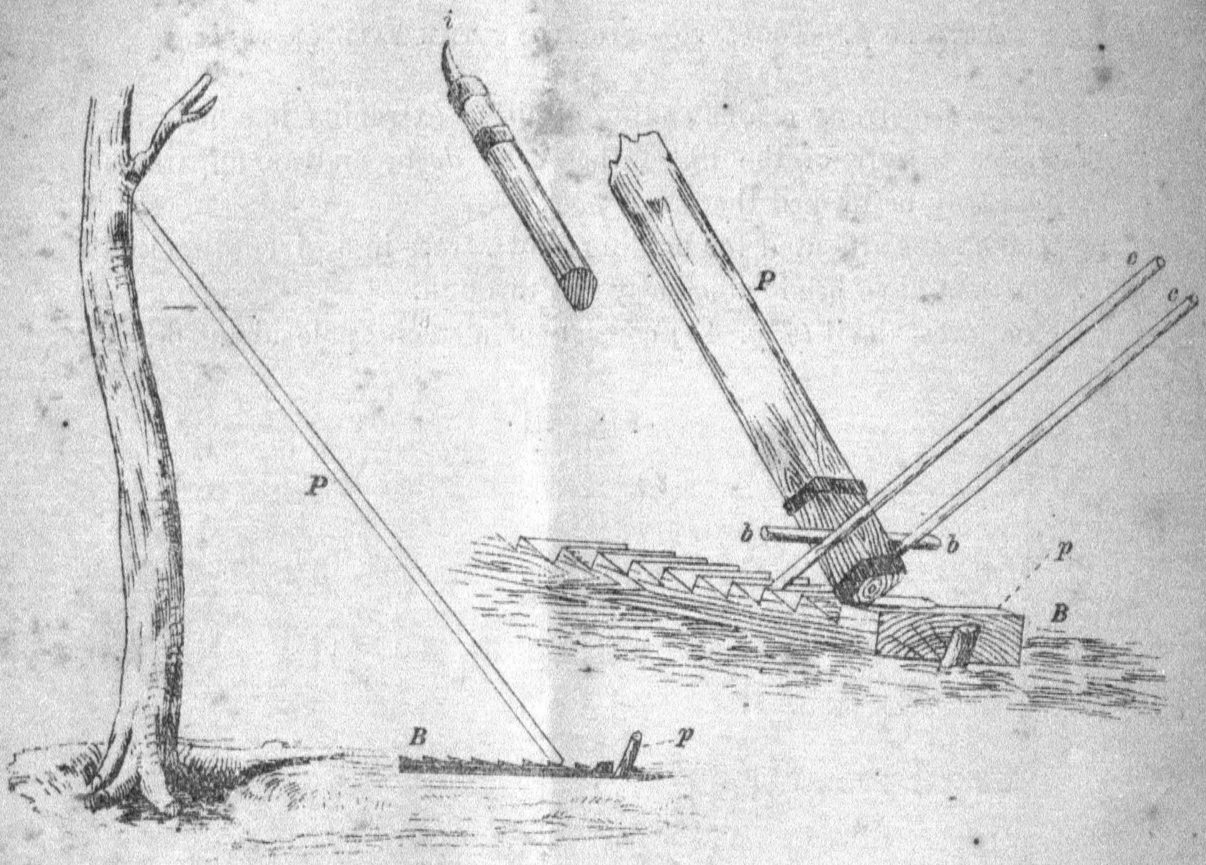
The Forest Devil. (*After Gayer*).

long, to which are fixed the three chains *A* (of indefinite length) and *B* and *B'* (of short length), and ending each in a hook that can be hitched on to any link of the free chain *C*, which is attached to the tree to be felled. The chain *A* is secured to a stump or standing tree. As the tree to be felled is pulled and sways forward more and more, the hooks at the end respectively of

B and *B′* are hitched forward alternately a link or two at a time, until the tree is completely pulled over.

The thrust pole (*Fig.* 44) consists of (i) a straight stout pole *P*,

Fig. 44.



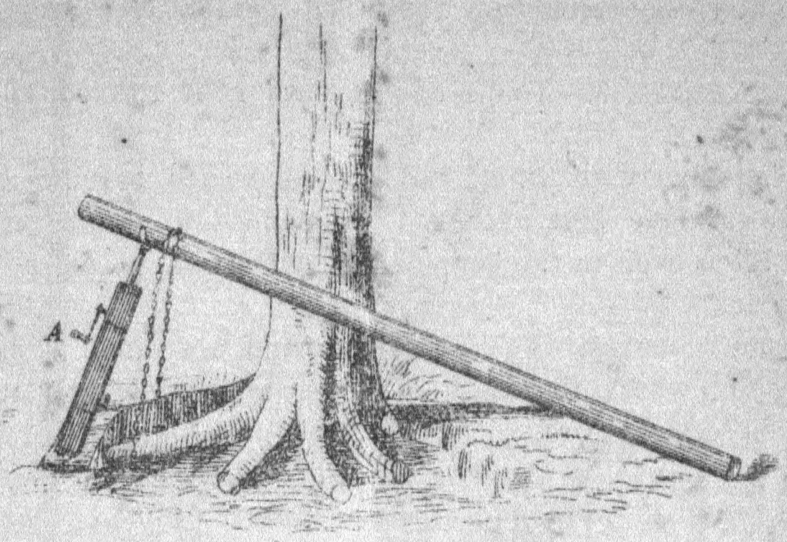
The Thrust Pole. (*After Gayer*).

the upper end of which is armed with a strong iron point *i*, while an iron bar *bb* passes through a hole a few inches above the lower extremity; (ii) a block *B* of some hard tough wood, the upper surface of which is serrated, and which is prevented from moving backwards by the peg *p* driven into the ground; and (iii) two crowbars or iron levers, *c*, *c*.

Article 6.—Tools for uprooting trees and stumps.

These tools comprise grubbing axes (already described on p. 291), grubbing chisels, the forest devil (already described on p. 333), the *stool-wrench*, the thrust pole (see above), and the screw-jack (*A* in *Fig.* 45).

Fig. 45.

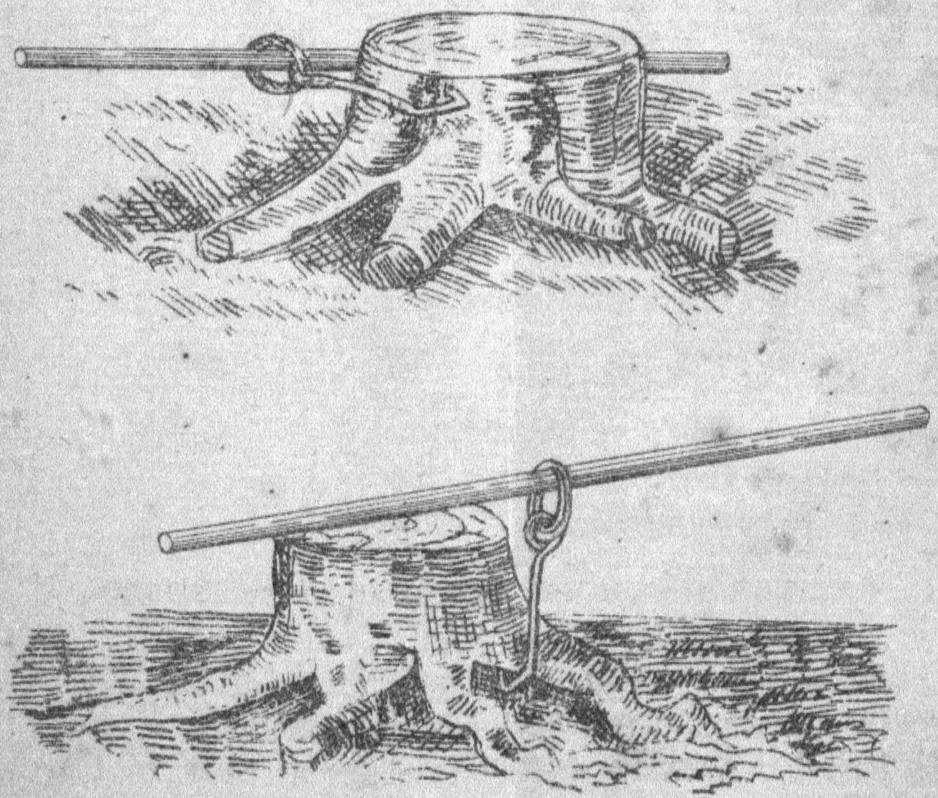


The Screw-Jack. (After Gayer).

A grubbing chisel is simply a long iron chisel edged with steel and used on roots that cannot be reached with a grubbing axe.

The stool-wrench (*Fig.* 46) consists of a strong hook *h*, which slides easily on a crowbar, *c*.

Fig. 46.



The Stool-Wrench. (After Gayer).

The screw-jack is well known to every one who has been at a railway station. Its employment, as well as that of the thrust-pole and stool-wrench, is sufficiently evident from the illustrations.

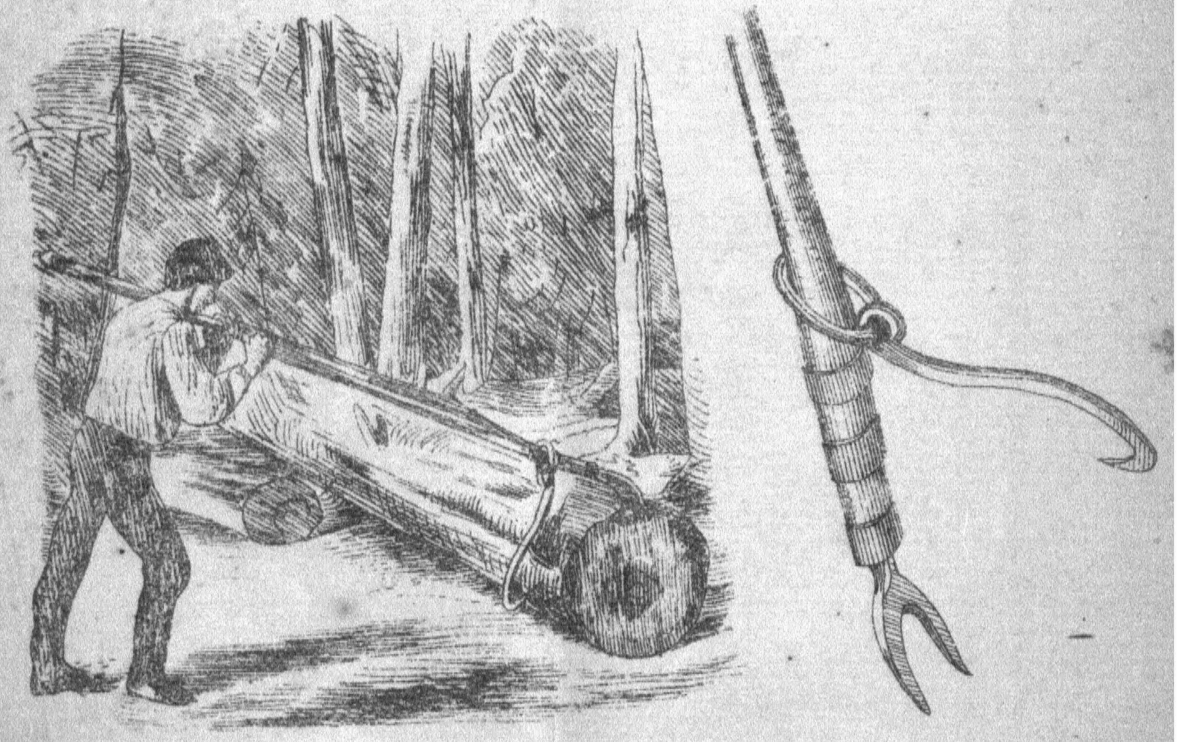
Article 7.—Tools for moving logs for conversion.

The tools with which we are concerned here are only such as serve to move logs over short distances to points in the forest, and often even in the coupe itself, where they can be easily converted.

Rough tools always ready to hand are small round billets or poles on which the logs are rolled and sufficiently strong, short poles used as levers, with which they are rolled along.

A wonderfully convenient and effective tool for rolling logs along is what we may term the *hook-lever* (*Fig.* 47), an implement

Fig. 47.



The Hook-Lever. (*After Gayer*).

of German origin, which consists of a hook, similar to that of the stool-wrench, sliding on a stout pole that is shod with a two-pronged fork.

SECTION IV.—SEASON FOR FELLING AND CONVERSION IN THE FOREST.

(1). *Season for felling.*

On the season in which trees are felled depend the technical properties of the wood, and even the possibility of carrying out the work, for labour may not be available in sufficient quantity and at reasonable cost throughout the year, and malaria or heavy rain or snow may be a bar to all operations.

To prevent cracks timber should be allowed to season slowly. Hence it should be felled in damp and cool (if possible, even cold) weather. Where there is a true winter, felling in winter also preserves the wood from fermentation of the sap, from infection by fungus spores, and from the attacks of insects. With regard to durability alone, the theoretically best time for felling occurs when the trees contain their minimum of reserve materials (see page 14, para. 3), that is to say, generally just after the new flush of leaves is out. But this season can be observed only when it does not coincide with the appearance of new seedlings, which the felling and export operations are bound to destroy; or with the season of heavy rains, during which the ground would be soft and muddy and the advance growth, if there is any, full of tender and easily-injured shoots. It may of course be observed in coupes that are to be clear-felled and then re-stocked artificially. For the safety of young growth the best time for felling is the season of repose, when the plants are least fragile and possess their greatest recuperative power; but on the higher ranges of the Himalayas the snow lies too heavy for felling to take place then without risk to human life, and, as export must take place during the following summer, most of the trees have to be cut in spring, while the seedlings are only just sprouting or coming up from seed.

As regards firewood, we know that the quicker it dries, the better it is; also that it is heavier the more full it is of reserve materials. Hence in felling for firewood, the best time of the year, provided sylvicultural exigencies do not bar it, is when dry, warm weather prevails; and if this coincides with the season of repose, so much the better. The time for felling coppice is limited, by purely sylvicultural considerations, to this season, the only exception being when bark for tanning is the chief produce sought, in which case the felling must be effected during the first three or four weeks of the season of vegetation, unless the trees are barked standing, or this period falls within the rainy season. In the case of charcoal-making, the charcoal-burners must have a sufficiently long spell of

fairly dry weather in which to complete their work. Cleanings and early thinnings, in which the poles are cut as they are selected, must of course be effected while the forest is in full leaf.

The season when alone floating is practicable fixes the period within which wood that is to be removed by water must be cut. The condition of the market may also exercise a determining influence. For instance, purchasers who require a certain class of fresh-cut produce may offer themselves only at a certain time of the year.

Lastly, when the trees are to be removed by the roots, the work must be undertaken while the soil is still sufficiently moist to be easily dug.

The general conclusion to be drawn from what precedes is that the period for felling will always vary with the locality and climate and with the purpose to be served ; but, as a general rule, in the higher Himalayas, where heavy snow falls and lies, it will comprise the spring and early part of summer, while elsewhere it will extend over the cooler portion of the season of rest.

(2). *Season for conversion.*

As a rule, the limited amount of conversion to which wood is subjected in the forest is effected *pari passu* with the felling operations, as such an arrangement economises labour and supervision, and every kind of conversion is effected most easily while the wood is green. But it may happen that the time in which the coupe must be cleared does not allow of the work being completed, and in this case only the roughest kind of conversion is permissible before the produce is removed to the nearest special conversion depôts.

When the market requires fresh-cut produce, the date on which delivery must be made and the time occupied in export fix rigidly the season for the conversion operations.

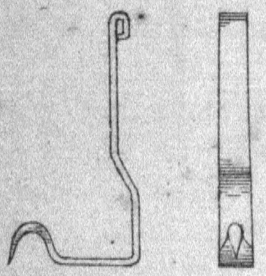
Section V.—Felling.

In felling a tree we have to keep in view three main objects—(1) realisation of the largest outturn in money or produce that it can yield, (2) facility, sometimes even possibility, of export, and (3) safety of the soil and surrounding forest.

In order to secure the first object, the timber-yielding portion of the tree should be preserved as intact as possible. Hence the bole of a heavy tree should not be allowed to fall across a hollow or across any projection, such as a ridge, rock, or boulder, or a fallen

tree. The bole of a tree will often break across owing simply to its strong ample crown striking the ground first. When this danger is apprehended, it will be necessary to lop off the larger boughs, or even remove the whole or the greater part of the crown. Such a proceeding will also cause the tree to fall much lighter. A very tall tree, like a deodar, pine, or fir, cannot, under any circumstances, be saved from breaking, and the only plan to adopt, when it is feasible, is to remove the upper portion of the bole in sections from the standing tree. For this purpose expert and fearless men, such as can be found in few places in India, must be obtained, and climbing irons used (*Fig.* 48).

Fig. 48.



Climbing Iron. (*After Boppe.*)

On a slope, a tree falls through the smallest angle, *i.e.*, with least momentum, if felled towards the hill; but unless the tree is well secured, there is danger for the workmen as well as for the tree, if the ground is precipitous, from the tree slipping down hill. Hence it is best to make the tree fall more or less on a horizontal contour line, so that it may be at once caught up against the foot of the trees just below that line.

The trunk is liable to split along a considerable portion of its length if the tree falls before it is cut through. Hence a heavy tree, which originally bears down very much on the side on which it is to fall, should be held back or propped up until it is cut through, or a portion of its crown on that side should be removed. Moreover, no felling should be done in a high wind, which would, besides, prevent the woodmen from having any control in directing the fall of the tree in a given quarter.

The utilizable underground portion of a tree constitutes up to one-fourth the gross outturn of the portion above ground, and the amount of timber rendered useless or lost by felling the tree above ground may run up to from 6 to 10 per cent. of all the timber in the tree. To prevent this loss the trees should be felled by the roots, whenever the safety of the soil and surrounding vegetation and the nature of the soil and locality will permit, and the value of the wood thereby saved at least covers the extra expenditure it occasions. Even if there is no timber to be saved, this mode of felling is to be preferred, for, unless powerful machinery is available, there is no work so slow and arduous as grubbing out stumps—a mode of utilization that also yields a very large proportion of chips, which either have little value or are totally unsaleable. Neverthe-

less, when time is limited, it may be necessary to fell above ground and then extract the stumps at leisure.

The removal of the underground stock has, from a sylvicultural point of view, the advantage that it thoroughly loosens the soil and thus favours the germination of seeds and the establishment and growth of seedlings. On the other hand, such loosening of the soil is dangerous on sloping ground or ground that is subject to inundation, while in sandy or otherwise dry and barren land it deprives the soil of so much manurial matter, and renders it too freely permeable to water.

If a large tree has to be exported in the log, it should not be allowed to fall or roll into a ravine or other hollow, from which its extraction would be impossible or extremely laborious and expensive.

To restrict, as much as possible, the damage to surrounding forest inevitable in all felling operations, the fall of every tree should be so directed that the tree may fall inside a gap between surrounding trees, or over a spot where there is least reproduction. In the midst of a close forest or abundant young growth the crown must be reduced, or may have to be altogether removed, particularly if the tree is very tall, as it is the portions farthest from the ground which acquire the greatest momentum, and therefore do most damage. In felling over dense very young growth, as in the case of after-fellings or in jardinage coupes, the seedlings should first be carefully bent away to either side, so as to form a narrow lane into which the tree may fall.

If, in spite of every precaution, a tree falls upon another so that its crown gets entangled in that of the latter and cannot be disengaged by merely trying to pull it away, then either a log or two must be cut off from the bottom, or, that expedient failing, one or more branches of the standing tree must be sacrificed.

As a rule, the amount of felled material lying on the coupe at any time should not exceed what may be cut up and removed within the next two or three days. Hence conversion should progress *pari passu* with the felling operations.

All large coupes should be divided into sections small enough to be worked by a single gang, and in each section the work must begin at one end and progress successively to the other end. On a slope the boundary lines between the sections should run straight up and down hill, and each section should run down the entire length of the slope, so that no gang may endanger another by felling above it. Small drainage basins or separate sides of a larger one constitute the most convenient sections. In each section

work must begin at the highest point, so that all the trees in the portions not yet operated in may aid in preventing the trees felled above them from slipping or rolling down. In clear fellings on level ground, as, for instance, in coppice coupes, the trees should be made to fall in the direction opposite to that in which the work is progressing, so that every portion of the area in which the fellings are still to be made may be quite clear of fallen material. Where a constant wind blows, the work should begin on the edge of each section and progress against the wind.

Trees may be felled either with some chopping instrument alone, or with the saw alone, or with a chopping tool and the saw combined. Stems cut back for coppice will not admit of the use of a saw, which would leave a spongy absorbent surface that would afterwards have to be smoothed with an axe or adze at great additional expense.

The different modes of felling will now be sketched in broad lines.

Article 1.—Felling above ground.

(1). *Felling with chopping tools alone.*

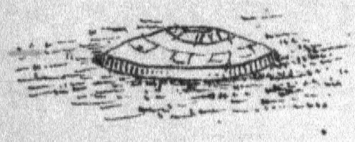
Nothing special need be said here regarding the cutting down of saplings, except that when they are expected to coppice, their base should be supported with a stout piece of hard, knotty wood, in order to prevent the roots from being injured by the shock of the felling axe or bill.

In cutting back small poles, the fall of which, owing to their lightness, is easily directed, it is usually found convenient to cut all round the stem, thus giving the butt of the detached pole the form of an inverted cone.

In the case of larger stems, the fall of which it is important or absolutely necessary to direct, a horizontal cut should first be made on the side on which the tree should fall and extending to a little beyond half the diameter. This depth of cut is needed to prevent the bole, when the tree is beginning to fall, from splitting along the whole or some portion of its length—an accident of frequent occurrence with unskilful workmen. Another advantage gained is that if the tree is perfectly symmetrical, the vertical through its centre of gravity falls inside the cut, and the weight alone of the tree then bears it down on the side on which it has to fall. Even when the tree is over-developed on the opposite side, the deep cut helps it to be pushed or pulled over more easily

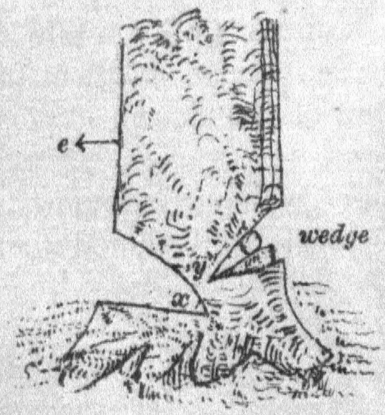
in the required direction. The second cut should be made exactly on the opposite side and almost meet the first. The operation is then completed by deepening this latter until the tree falls. The second cut may be made on the same level as the first one, so that the stump of the tree is given a perfectly horizontal section. This mode of cutting is indispensable in felling for coppice, in which case the stool is still further dressed into the form of a flat dome by sloping off the edge all round (*Fig.* 49). In all other cases there is very great advantage in beginning the second cut from 6 to 10 inches higher up, according to the size of the tree, as all risk of the bole splitting upwards is thereby avoided, and the tree is much more easily forced to lean over to the side on which it is desired to make it fall. To still better secure this latter object, the second cut should be made slightly sloping downwards, as represented in the illustration below. Into such a cut wedges are easily driven in to force the tree to lean over to the opposite side. If the cut is wide, a billet of wood must be placed in it crosswise before the wedges can be inserted. The tree will fall only when the point *y* comes exactly over the point *x*, the fibres merely separating along *xy*.

Fig. 49.



Dome-shaped stool.

Fig. 50.



Mode of felling a large tree.

In making any cut, the woodman should never, until it is complete, allow its two surfaces to meet at a sharp angle, as otherwise the natural tendency of the axe to work downwards, instead of parallel to the upper surface, will make his work very difficult each time he tries to widen the cut at the top.

Trees exceeding 18 inches in diameter are often best felled by several men together. Men working on opposite sides should cut with different hands, otherwise the cuts will not be parallel, but form the letter *x*.

In making the two cuts necessary to fell a tree, a very large quantity of wood falls off in chips, while the wedge in which the butt-end of the felled tree terminates is of little or no use as timber.

The quantity of wood thus lost is said by Boppe to be approximately as follows, according to the size of the tree :—

Diameter at base, in inches.	*Depth of cut, in inches.*	*Wastage, in cubic feet.*
12	10	0·5
16	12	1·4
20	14	2·5
24	16	4·2
28—32	18—20	6·4— 8·8
36—40	20—22	11·8—16·0

Felling with the axe alone is thus a very wasteful method, and should be confined to stems having a diameter at the base of not more than 12 inches. Where timber is very valuable, the maximum diameter may be reduced to even 6 inches. One great advantage of the axe is that with stems up to 12 inches or so in diameter it works much more expeditiously than any other hand tool.

(2). *Felling with the saw alone.*

The saw is made to cut continuously on one side (opposite to that on which the tree is to fall) until the stem is nearly cut through. To prevent the saw from jamming, as well as to gradually force the tree over, two or more strong wedges are driven into the cut behind the saw. To facilitate this operation, if necessary, the tree may be pushed or pulled over with the usual tools. As the single cut extends almost to the bark on the opposite side, unless the wedges are driven in skilfully, the tree is likely to fall in almost any direction within an angle of nearly 180°.

The amount of kerf is so small, that for all practical purposes there is absolutely no waste of wood with the saw. The saw should be used in felling all trees exceeding, according to the value of the timber, from 6 to 12 inches in diameter.

It is allowable to use the axe in order to round off buttresses and other irregularities.

(3). *Felling with the saw and axe combined.*

In this case a first cut is made with an axe on the side on which the tree is required to fall. This cut extends into the stem for only a fourth or fifth of its diameter, and its object is simply to

make the work of the saw easier and to secure with certainty the fall of the stem in the exact direction desired. The saw-cut is made and opened out in the same way as when the saw alone is used.

Article 2.—Felling by the roots.

All the main roots are laid bare with the help of picks, the smaller roots that come in the way being cut through with grubbing axes. The former are then severed with the axe or a curved saw, whichever is more convenient, those being cut last which anchor the tree on the side opposite to that on which it is to fall.

If the tree has no tap root or any other large roots penetrating into the ground more or less vertically, the procedure is very simple. All the main roots are laid completely bare up to the point at which they cease to have useful dimensions. In doing this, the secondary and other subordinate roots are cut through and removed with grubbing axes. The upper main roots, which are also the largest, are first severed close to the trunk with axes or a short curved saw, and then cut through at the further end and torn up with grubbing axes and wooden levers (poles of some hard, strong wood, from 6 to 10 feet long and cut into the form of a wedge at the thick end). The lower roots, on the contrary, are severed first where they are thinnest, as they are then more easily lifted up and broken off. The roots on the side opposite to that on which the tree is to fall should be cut last, and from the beginning the tree should, with the aid of a hook and chain or the thrust-pole, be forced gradually to lean over until the enormous leverage exercised by its crown brings it down, tearing asunder all the smaller roots that are still holding it. These roots cause the tree to fall slowly, and therefore with much less momentum, than if it were felled above ground, and hence, in this system of felling, there is less occasion for reducing the crown.

If the tree has a tap root or other roots running down more or less vertically, the upper roots are cut and removed as in the preceding case. When there is only a tap root, this should be cut into obliquely on two opposite sides, the cut on the side opposite to that on which the tree is to fall being deeper and the one by which the felling is completed. To help in deepening this cut as well as in bringing down the tree, a number of men should tug away at the tree in the direction in which it is to fall. By alternately pulling and giving, and causing the crown to sway forwards

and backwards, greater effect is secured, and to prevent the trunk from swaying back too far, poles, thrust under it on that side, should be pushed in further and further as the tree bends forward more and more. In the case of several vertical roots, they must be cut through one by one, the most easily reached being attacked first, and the last being cut in the same manner as the single tap root.

When a screw-jack is available, trees with only large horizontal roots may be felled in the manner shown in *Fig.* 45.

Article 3.—Grubbing out of stumps.

The same procedure may be adopted here as in felling a tree, except that the enormous leverage of the crown and trunk is now entirely absent, and practically all the roots must be completely cut through. For the leverage of the upper portion of the tree must be substituted the action of the forest devil (*Fig.* 43), or of the stool-wrench (*Fig.* 46), or of the screw-jack (*Fig.* 45), or of windlasses, derricks, or winches.

Another way is to split and chip up the stump, converting it at once into firewood ; but owing to the knottiness and crossing of fibres which characterise this portion of most trees, especially of broad-leaved species, this mode of extraction is generally extremely slow and can be adopted only very exceptionally.

Lastly, blasting powder or dynamite may be used. The blast-hole is made with a strong gimlet. It is best to bore it downwards through the centre of the stump ; but in case of rottenness there, it should be bored sideways along a radius. In blasting with powder, the charge will be from 2 to 5 ounces, according to the size and nature of the stump, and the tamping should be done with clay or stiff loam. In the case of dynamite the charge will vary from 1 to 5 ounces, from 2 to 3 ounces sufficing, according to Gayer, for a stump from 20 to 28 inches in diameter. The stick of dynamite is put into the hole and rammed in tight with a wooden rod. Above this, in close contact, is placed the detonator containing the cap, to which the fuse is securely fixed. The rest of the blast hole is filled with clay or loam or fine sand. The fuse is fired with a burning piece of tinder placed in contact. When powder is used, the effect is often merely to rend the stool asunder, whereas the very much more powerful dynamite usually blows it up into numerous small fragments.

(*To be continued*).

SOME ASPECTS OF FOREST ADMINISTRATION IN INDIA.

I.—The Financial Results of the present system of Management.

The rapid increase during recent years of the surplus revenue* from the forests in India is, no doubt, a most satisfactory feature. Without this, for instance, the development, such as it is, of the Department, would, for financial reasons, have been impracticable. But it is a question whether we have not been led to lay too much stress on the mere increase of the surplus revenue to the neglect of other equally or more important factors in a successful system of forest management. The fact that it is sometimes brought forward, even by Forest Officers themselves, as sufficient proof of the excellence of our system of forest management, that proportionately less money is being spent on the management of the forests in India than in other more advanced countries, and that to state that the surplus revenues of his charge increased during the period of his management is considered the highest praise that can be bestowed on a retiring Forest official, shows that a tendency exists to exaggerate the importance of financial results alone.

It is, therefore, the duty of Forest Officers, as the responsible advisers of Government with regard to the management of the forest estates in this country, to expose the worthlessness of what may be called the "financial measure" of success when not adequately qualified. The longer the prevailing fallacy is left unchallenged the more difficult its refutation becomes, and the harder the task of those officers who see the evil and wish to correct it. An increasing revenue appeals to the authorities as no other argument can, and it is much easier—and as regards the immediate interests of the individual, much more profitable—to swim with the current than against it.

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* This (at intervals of ten years) was as follows in—

1867-68,	...	...	...	...	Rs. 10,98,757
1877-78,	..	...	...	...	„ 25,09,779
1887-88,	...	...	...	...	„ 44,99,922

and two years later, in 1889-90, with the addition of Upper Burma, the surplus promises to be from Rs. 65,00,000 to 70,00,000.

Unfortunately the greater portion of the forests in India cannot be exploited without undertaking works connected with the extraction of the produce, so that the system of accounts necessarily in force acts as a blind in concealing the real nature of much of the forest expenditure that is incurred. When the gross revenue and expenditure are each treated as one whole, it may appear as if large sums were being spent on forest maintenance, whereas in reality the whole of the expenditure may have been incurred in connection with timber works. Such expenditure is, however, merely an *advance*, which is recovered when the produce is sold, and no part of it can be said to be devoted to the maintenance or improvement of the forests, though some of it may indirectly swell the revenue by causing an enhancement of prices at the centres where the produce is sold.

Although the accounts as they stand show little or nothing, a rough idea of the true results of each year's working may be gathered from the annual Form No. 62. The following Table has been compiled from this form, and shows the average annual revenue and expenditure during the past ten years* in India, as compared with that budgetted for last year in France, which country has been chosen as affording a fair example of the system of forest management in force in Europe:—

Country.	Revenue.			Expenditure.			Percentage of True Gross Revenue spent on the Maintenance and Improvement of Forests.
	True Gross Revenue.	Advances for Timber Works and the extraction of produce, &c., recovered.	Total Gross Revenue.	On advances for Timber Works (collection of Revenue, &c.), including a portion of salaries of Establishments.	On the Maintenance and Improvement of the Forests, including balance of salaries of Establishments.	Total Gross Expenditure.	
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
India, ...	64,95,937	45,60,949	1,10,56,886	45,60,949	20,95,678	66,56,627	32
France,	1,21,03,000	Nil.	1,21,03,000	Nil.	65,48,000	65,48,000	54

For purposes of comparison a rupee has been taken as equivalent to 2 francs. The figures for France are taken from the French Forest Budget for 1889 as published in the *Annuaire des Eaux et Forêts* for that year.

* Not including the relatively small sums expended or received in Ajmere, Coorg, and Baluchistan.

Briefly stated, this table shows that whereas in France, where the salaries of the officers of the superior forest staff are very much less than in India, over one-half of the true gross revenue (*i.e.*, the value *as it stood in the forest* of the produce sold) is spent on the improvement of the forests, in India *less than one-third* of this true gross revenue is spent for similar purposes.

It is unfortunate that we cannot ascertain from Form No. 62 how much of the expenditure incurred on the "Formation, Improvement, and Protection of the Forests" is spent on "Establishments," and how much on "Works of Improvement." In the detailed statements of accounts, no allowance is made for the time spent by the establishment in supervising timber and other works connected with the extraction and sale of the produce. It is, therefore, impossible to gather from them what proportion of the expenditure should be credited to the maintenance and improvement of the forests, and what to timber works pure and simple. Neglecting, however, this element of inaccuracy, a comparison between the French and English Forest Budgets for 1889—the former country being again taken as the representative of European Forest Management—shows that in France, with an average gross revenue (taking the rupee as equivalent to 2 francs) of Rs. 2,952 per square mile, a sum of Rs. 870 per square mile, or 30 per cent. of the gross revenue, is spent on works of improvement, and Rs. 727, or 24 per cent., on the salaries of the establishment. In India, however, although the average gross revenue per square mile of land under the control of the Forest Department is only Rs. 142 (and of this sum, only Rs. 114 is, under any circumstances, real revenue, as Rs. 28 represents the recoveries of advances directly made in connection with the works for the extraction of the produce sold), only Rs. 18, or 16 per cent., is spent on works of forest maintenance and improvement, while Rs. 34, or 30 per cent., is spent on establishments. A great part of the time of this establishment is, however, employed in supervising timber operations, or works connected with them, and consequently a large portion of the pay of the establishment, probably on an average not less than half of the total charge, should be debited to timber works and not to forest maintenance and improvement at all.

The comparison, after making this allowance, may, therefore, be shown in a tabular form as follows :—

Country.	Gross Revenue.			Expenditure per square mile.				Net Surplus per square mile.	Remarks.
	Real Gross Revenue.	Advances on Timber Works recovered.	Total Gross Revenue.	On Timber Works (including a portion of the salaries of Establishment employed on Timber Works).	On works of Forest Improvement.	On balance of Establishments employed on the maintenance of the Forests.	Total Expenditure.		
	Rs.	Rs.	Rs	Rs.	Rs.	Rs.	Rs.	Rs.	
India, ...	114	28	142	45	18	18	81	61	Figures from Budget 1888-89, but area for 1888.
France, ...	2,952	Nil.	2,952	Nil.	870	727	1,597	1,355	

Taking the *percentage of the real gross revenue spent* as the basis of comparison, the result, on the assumption, as stated above, that one-half the time of the permanent forest establishments is devoted to supervising timber and similar works, is as follows :—

Country.	Percentage of real Gross Revenue expended per Square Mile.		
	On works of Forest Improvement.	On Establishments employed on maintenance and protection.	Total.
India, ...	16	16	32
France, ...	30	24	54

The conclusion to be drawn from these statements is that in India we are spending far too little on the maintenance and improvement of our forests, and that an immediate reform in this direction is necessary. This fact ought to be fully recognized ; for, until it is, every Forest Officer will continue to be called upon to increase the surplus forest revenue from the area in his charge, practically without reference to the state of the forests or their requirements

The following is a summary of the figures on which the above statements are based :—

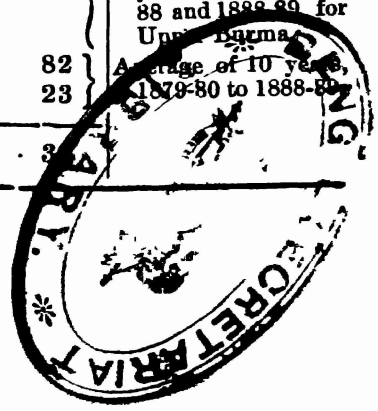
INDIAN AND FRENCH FOREST BUDGETS COMPARED.

Heading.	India Budget, 1888-89 (Forest area, 97,386 sq. miles).	France Budget, 1889 (Forest area, 11,523 sq. miles).
EXPENDITURE.	Rs.	Rs.
Salaries of Superior Staff, ...	13,11,998	12,65,000
,, Subordinate Staff, ...	14,31,447	12,96,500
Travelling and other allowances and contingencies, ...	5,82,946	3,41,000
Forest Instruction, including salaries of Professors, ...	32,961	77,000
Works of forest improvement (including, in India, half charges for Live-Stock and Stores),...	18,02,122	35,68,500
Advances made for Timber Works (including remaining half charges for Live-Stock and Stores), ...	27,51,149	Nil.
Total Estimated Expenditure,...	79,12,623	65,48,000
REVENUE.		
Net value, standing in the forest, of produce sold, ...	1,11,43,410	1,21,03,000
Recoveries of advances made in connection with works for the extraction, &c., of the produce, ...	27,51,149	Nil.
Total Estimated Revenue,...	1,38,94,559	1,21,03,000

Note.—In compiling the above statement, the rupee has been taken as equal to two francs. It should also be noted that the foregoing statement of the French revenue does not include the contribution paid by the communes in France for the services of the Forest Officers employed in supervising the management of the Communal Forests, the proceeds from which are not entered in the Forest Budget. Nor does the expenditure include the sum (probably about Rs. 50,000) spent on the Central Office of control at Paris, which is charged to the Department of Agriculture. These additions, if made, would make the comparison still more unfavourable for India.

Average Forest Revenue and Expenditure, India.

Province.	Revenue.			Expenditure.			Percentage of the true Gross Revenue spent on the Improvement and Maintenance of the Forests.	Remarks.
	True Gross Revenue.	Recovered advances made on account of Timber Works.	Total Gross Revenue.	Advances made for Timber Works (including a portion of the salaries of the permanent establishment).	Maintenance and Improvement of the Forests (including balance of salaries of the permanent establishment).	Total Gross Expenditure.		
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.		
Madras, ...	5,28,131	4,45,070	9,73,201	4,45,070	3,40,714	7,85,784	65	Average of 10 years, 1879-80 to 1888-89.
Bombay, ...	17,49,665	10,57,571	28,07,236	10,57,571	6,11,243	16,68,814	35	Average of 7 years, 1882-83 to 1888-89.
Bengal, ...	3,94,742	2,24,239	6,18,981	2,24,239	1,49,698	3,73,937	38	Average of 10 years, 1879-80 to 1888-89.
N.-W. P. & Oudh,	6,84,873	6,13,987	12,98,860	6,13,987	2,63,595	8,77,582	39	
Punjab, ...	3,96,202	4,28,443	8,24,645	4,28,443	1,64,268	5,92,711	41	
Central Provinces,	6,93,481	3,33,010	10,26,491	3,33,010	1,59,755	4,92,765	23	
Burma, ...	16,96,320	12,83,430	29,79,750	12,83,430	2,41,259	15,24,689	14	Ditto for Lower Burma. Average of two years only, 1887-88 and 1888-89 for Upper Burma.
Assam, ...	1,42,047	69,924	2,11,971	69,924	1,17,134	1,87,058	82	Average of 10 years, 1879-80 to 1888-89.
Berar, ...	2,10,476	1,05,275	3,15,751	1,05,275	48,012	1,53,287	23	
Total, ...	64,95,937	45,60,949	1,10,56,886	45,60,949	20,95,678	66,56,627	3[illegible]	



II.—The Forest Staff: its Composition and Strength.

In order that the officers of the Forest Service in India may be able to manage the forests in their charge as efficiently as the State forests in European countries are managed by similar Departments—and this is what the Indian Forest Department aims at doing even at present—it is necessary that they should be numerically as strong, relatively to the work to be done, as experience has shown to be necessary in Europe. As the revenue per unit of area from our Indian forests is, we have seen, hardly one-twentieth what the French forests yield, we may assume that, to some extent at least, the work connected with the management of forests in India, in their present undeveloped state, is proportionately less. But, allowing for this, it is indispensable, for financial reasons, if as strong a staff relatively to the work to be done is to be employed, that the *average* pay of the Indian forest staff should not be at any rate *higher* than the *average* pay of the staff of European Forest Departments.

As, however, Forest Officers of the superior grades, possessing the amount of administrative ability and professional skill that is required to control and direct forest management, cost in India about *three times* as much as in Europe, it is necessary, if the average pay is not to be higher than in Europe, that the India staff should consist of as few such officers as is possible, and should in the main be composed of Natives of the country drawing less pay than officers charged with similar duties in Europe.

This is a mere matter of arithmetic, but nevertheless, up to the present, it has not been sufficiently recognized, or at any rate has not been acted on.

The difference between the average cost of the Forest Staff in India and the cost of similar staffs in Europe, even after making every allowance for the lesser *intensity* of the forest working in India, is enormous.

According to the last "*Annuaire des Eaux et Forêts*," the officers on the active list in the French Service budgetted for in 1889 were as follows:—

32	Conservators, at 8,000 to 12,000 francs a year each,	290,500
418	Inspecteurs, at 3,000 to 6,000 francs, ..	1,693,000
300	Gardes Généraux, at 1,500 to 2,600 francs, ..	598,132
Total 750	Officers in charge of forest area, costing francs,	2,581,632

There were, besides, 3 Inspectors-General on an average pay of about 15,000 francs a year; 2 Conservators on 12,000 francs, each acting as Directors of Forest Schools; and 12 Deputies acting as Professors on about 5,000 francs each: also some 31 officers whose services had been lent to other departments or to foreign Governments, &c., whose pay was not budgetted for.

In Hungary there are 505 officers of the superior service employed on the management of the State forests at a cost of £93,550 a year, or, say, Rs. 1,30,00,000 a year.*

The average pay of each officer of the superior Forest Staff (I am alluding only to the Superior Service in this Note) in France, therefore, amounts to only about Rs. 1,700 or Rs. 1,800 a year.

In Hungary, which, in view of the fact that a Forest Department was only started there some ten years ago, may be taken, as compared with France, as the opposite pole of European forest organization, the average annual cost of each officer of the superior Forest Staff is about Rs. 2,600.

In India, however, the present sanctioned scale of the superior or controlling Forest Staff is :—

1	Inspector-General, costing,	say,	...	Rs. 27,000	a year.
18	Conservators,	„	...	„ 2,61,960	„
102	Deputy Conservators,	„	...	„ 8,38,188	„
64	Asst. Conservators,	„	...	„ 2,96,124	„
185	Officers,	„	...	Rs. 14,23,272	„

So that the average cost of each officer comes to, in round numbers, Rs. 7,700 a year.

As regards the size of the charges held by Forest Officers in India as compared with those held by officers of similar rank in European countries, these are fifteen or twenty times as large in India. The forest area in France under the control of the Forest Department, according to the latest returns (*vide Annuaire*), is 4,123 square miles of State forests (*Forêts Domaniales*), and 7,400 square miles of Communal forests (*Forêts Communales et d'Etablissements publics*), which are managed by the State Department, but of which the revenues belong to the Communes. In India the area under the control of the Forest Department at the end of March, 1888, amounted to 79,710 square miles of "reserved" and "protected" forests, and 17,676 square miles of "unclassed" State

* *Vide* Colonel Bailey's pamphlet, "Forestry in Hungary," page 15.

forests ; in all 97,386 square miles. There are in France 32 conservators' circles and 195 divisions (inspections and "chefferies" or minor divisions) ; and including the Directors of Forest Schools, Inspectors-General of Forests, officers lent to other Departments, &c., &c., but not officers on the Unattached List, there are in all 798 officers on the Active List.

In India there are 18 conservators' circles, about 98 divisional charges, and in all 185 officers in the controlling staff. The comparison between France and India is, therefore, as follows :—

	India.	France.
Average area in square miles of each Conservator's charge, ...	5,410	360
Average area in square miles of each Divisional Officer's charge, ...	994	59
Average area in square miles per member of superior staff, ...	527	14

It is evident, therefore, that the Indian Staff must be increased so as to come somewhat nearer what European experience shows to be necessary, and that, in view of the high cost of European service and the miserable yield from the forests, the additional Staff employed must be from Natives of the country. We may in fact conclude that eventually it will be necessary to place all Forest Divisions in charge of Natives of India trained at an Indian Forest School, and to limit the employment of the more expensive European officers (except during some years while learning their work) to the higher duties of inspection and control work only.

Under such a system there would be, we may suppose, one *Chief Forest Officer* (who might be called Conservator or Provincial Inspector-General, the latter by preference) under each local Government or Administration. As it is essential that each local Government should have a single Forest Adviser in a position in which he can be useful, this officer might, with advantage, be Joint Secretary, as similar officers are in the Public Works Department. The Chief Forest Officer, we may assume, would be assisted by Deputy Inspectors-General (or Deputy Conservators, if it was preferred to adhere to the old names, but these officers would be relieved of their present executive work), whose duty it would be to increase what we may call the "inspecting power" of the Chief Forest Officer, enforce the forest policy of the Local Government, and generally control the District or Divisional Officers and see that the forests were being properly worked. These officers would of course be exclusively European trained men, and with

the Chief Forest Officer would constitute the upper or Controlling Staff of the Department.

The Divisional or District Forest Officers would, as already stated, be Natives of India trained at an Indian Forest School. Their pay should be sufficiently good* to attract to the service educated men of the stamp that is required, but would naturally be very much lower than what is required to secure the services of qualified Europeans. They would be recruited from the ranks of the Ranger class, who would necessarily be trained foresters, and to whom the former would bear the same relation as Conservators at present bear to Deputy and Assistant Conservators.

A rough estimate may, even at present, be made of the Staff that would be required to manage the forests of India in the manner in which European forests are managed were this staff composed as here sketched out.

We may assume that the *demarcated* or *reserved* area under the control of the Forest Department will before long reach the total of, say, 100,000 square miles, and that it will be found that, on an average for the whole of India, *one* officer of the Ranger class (when the prospects of that class have been sufficiently improved to attract good men, in the number that is required, to the service) is competent to take entire executive charge of a forest area of, say, 40 square miles. This, it is true, is a very much larger area than is held charge of by a "Garde-General" in France. But the average yield per unit of area from the forests in India is as yet, as we have seen, very much less than in France, and we may assume that the work connected with the management of the area is also to some extent proportionally less. Besides, this is an *average* and includes

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* *Note.*—The pay of a Conservator of Forests in France, like that of all officials in that country, would not be considered very high even by Natives of this country in these days. The position of Conservator is seldom attained before 30 years' of service in the Department, yet the pay only averages about Rs. 450 a month. A "Garde-General," who has the same social position and, as a rule, higher professional training and general education than an Assistant Conservator of Forests in India, gets on leaving the Forest School about Rs. 60 a month. The cost of living of such officers in France is out of all comparison higher than the cost of living in India for a Native of the country of the same social position. The general tendency is to overpay Natives of this country when employed on higher posts. But the Forest Department being, of all others, the least popular with educated Natives, cannot afford to set the example of regulating the pay of its higher Native subordinates according to their necessary expenses. It must pay higher than other Departments in order to get the same class of men.

Provinces containing vast areas of practically unworked forests. We may assume that the Chief Forest Officer under each local Government or Administration would, on an average for all India, require, including officers on special duty or on leave, &c., the assistance of about ten Deputies: also that each Deputy would on an average control five Divisional or District Officers, who would of course be in charge of very much smaller and compact charges than are held by Divisional Officers at present.

The Staff so composed, assuming that in view of the importance of forest work in India the average pay of all classes is improved, would be somewhat as follows :—

Number of Officers in each class.	Title.	Average Forest Area in the charge of each Officer of the class.	Average monthly pay of each Officer of the class.	Total Annual Cost.
		Square miles.	Rs.	Rs.
10	Chief Forest Officers or Provincial Inspectors-General, ..	10,000	1,600	1,92,000
100	Deputy Conservators, ..	1,000	900	10,80,000
500	Divisional or District Forest Officers, ..	200	300	18,00,000
2,500	Range or Executive Forest Officers, ..	40	100	30,00,000
3,110	Officers of Superior Service, ..	32	164	60,72,000

Note.—The first two classes would constitute the Imperial or upper controlling staff, and the last two classes the Provincial or lower controlling staff. The former would be entirely recruited in England, and the latter in India from the Forest Schools. Officers of the lower controlling staff would not be eligible for promotion to the upper, but officers of the latter would, on joining the Department, be employed on the duties of officers of the Lower Control Department. Officers of the lower controlling staff would be entirely recruited from the Ranger class, the lower grade of which they would enter on leaving their Forest School. The 500 Divisional Officers here given would include the 50 or 60 Assistant Conservators that would, as at present, be required to recruit the superior staff.

This scheme compares as follows with those at present in existence in India and in France :—

Country.	Forest Area under the control of the Department.	Number of Officers, including (in India) Rangers.	Average Forest Area per Officer of the Superior Service.	Average Annual Cost of each Officer.	Remarks.
	Square miles.	No.	Square miles.	Rs.	There are in addition to the 185 gazetted officers in the service, as already given, 66 Sub-Assistants and 233 Rangers at present employed in all India. It is assumed that the Rangers of the future would be of a better class and fit to be included in the superior service.
India (present), ..	97,386	484	201	3,672	
India (future), ..	100,000	3,110	32	1,952	
France, ...	11,523	798	14	1,750	

It may seem at first sight wild and chimerical even to contemplate such an increase to the existing establishment within a measurable distance of time. It is, however, quite certain that some such scheme—of which the essential features are the employment of Natives of India in vastly increased numbers, and with improved prospects, in the higher executive posts, while Europeans would be employed on the more important duties of inspection and control only—must, before long, be adopted. We cannot manage the forests of India in the same way as the State forests in Europe are managed, with a Staff of one executive officer on an average to every 200 square miles. It is equally certain that forests yielding only a few annas an acre, such as we find in India, cannot afford to pay for an adequate staff of Europeans at Indian rates of pay. Such exotics are too expensive for every-day use, except as Controlling Officers in the highest positions of the service ; and, whether good or bad, if we are to employ a sufficient Staff to manage the State forests or to work these on any other than timber contractors' methods, the officers in immediate control of the forests, as Divisional and Range officers, must eventually all be Natives of the country, who can live on *very much* smaller salaries than Europeans can.

The annual gross revenue from the forests of India already

approaches one hundred and fifty lakhs of rupees. This, according to European ideas of forest management, would justify an annual expenditure on establishments of some fifty lakhs, of which about one-half, or twenty-five lakhs, *ought to* be devoted to the payment of the salaries of the officers of superior service, instead of the thirteen odd lakhs at present expended.

But it must be remembered that the revenue has doubled in the course of the past ten years, and with an adequate establishment there is no reason why this should not be repeated in the next ten years. With a gross annual revenue of three hundred lakhs, it would be justifiable to spend a hundred lakhs on establishments, which sum would very nearly enable a staff of the strength indicated to be employed. The adoption of such a scheme in the immediate future is, therefore, quite within the bounds of possibility.

In any case, without increased expenditure and increased establishments, and an organization more in conformity with the requirements than exists at present, the forests of India cannot be managed as the State forests in European countries are managed; that is to say, permanently maintained in their highest state of productiveness.

W. E. D'ARCY.

THE ALOE AND ITS USES.—A few years ago the discovery was reported in these columns of the singular property which the juice of the Mexican Agave plant has of half-digesting meat, or of converting it into peptone, and it was pointed out at the time how valuable, from a commercial point of view, would be this cheap and cleanly method of peptonizing, compared to the ordinary methods of extracting the peptonizing ferment from the stomachs of pigs and other animals. The discoverer, M. Marcano, announces that the method has been in industrial use in Venezuela by pharmacists for three years, during which it has worked perfectly. He finds now that if the crushed tissue of the leaves is added, as well as the juice, the whole process can be completed at blood heat in six hours, instead of 36, as it takes with the juice alone. The discovery is a very singular one, and one which ought to have received more attention from physiologists and physicians than it has so far. It is quite remarkable that the cells of the clumsy Mexican plant should be able to perform so easily the most important function of the human stomach.—*Australasian.*

JJ. Official Papers.

A NOTE REGARDING CERTAIN INDIAN TANNING MATERIALS.

(Continued from page 320).

Terminalia—Myrobalans.

The above brief allusion to myrobalans suggests the desirability of re-publishing in this place a passage from the Report issued at the close of the Tanning Conference held at the late Exhibition :—

"The gentlemen present were able to recognize and give the trade names for most of the forms exhibited. They pointed out that *Terminalia Chebula* must never be round or spongy in texture. The good qualities were known in the trade to be oval and pointed, and on section, of a pale greenish-yellow colour, and solid in structure. This oblong and pointed form was thought to be the product of a separate species, but Dr. Watt explained that, in his opinion, it was only the young or unripe fruit of *T. Chebula.**

"Mr. Evans kindly promised to furnish samples of the various commercial qualities, in order that these might be communicated to India, in the hope of an effort being made to disseminate a knowledge of what constitutes good and bad qualities. It seems important, if the view was correct, that the oval and hard forms were but young fruits, that this fact should be published in India as widely as possible. The so-called Jubbulpur form of myrobalans was viewed as superior ; and Mr. Evans picked out specimens of what he regarded as the best quality shown, in order to compare these with myrobalans procured in London. Dr. Watt explained that it was one of the numerous unaccountable eccentricities of trade that, while thousands of square miles of the central table-

* The ripe fruit is also "oblong and pointed." May it not be that the "round" myrobalan, "spongy in texture," is the fruit of *T. belerica* ?—[Ed.]

land of India were covered with the myrobalan tree, the trade reports published by the Government of India revealed the fact that the Indian market was largely met by Ceylon. A gentleman offered what seemed a probable explanation*—the restrictions imposed by Forest Conservancy—restrictions which, he contended, in some instances sacrifice the minor forest products of India in the interests of timber. It was hinted that this state of affairs had two evil effects, *viz.*, it retarded the development of numerous industries throughout the empire, and it was an open question whether the minor products were not, after all, more valuable in themselves than the timber. Two samples of galls found upon the myrobalan trees were placed on the tables. That from *T. Chebula* was stated to be hopeful, but the very plentiful gall from *T. tomentosa*, obtained from the Reverend A. Campbell, in Chutia Nagpur, was, after it had been submitted to chemical examination, pronounced valueless.

"A number of other tanning materials were examined, but none seemed to afford sufficient interest to deserve special mention.

"At the close of the examination of tanning materials, the gentlemen adjourned to Dr. Watt's office, in order to discuss what action seemed desirable in the interests of the Indian tanning industry.

"It was urged that it was essentially necessary to have the better qualities of tanning materials carefully analysed ; and two gentlemen very kindly undertook to do this independently of each other, if they were supplied with samples. They agreed to communicate to the Government the results of their examinations.

"When asked what might be recommended to Government, it was stated that the only thing that could be done was to experiment with the production of extracts or half-stuffs, so as to overcome the heavy charges of transport and freight."

For the Indian use of Myrobalans, *see* Captain J. Stewart's remarks, p. 107.

Chemical Examination of Myrobalans.

One of the gentlemen who promised to furnish analysis of myrobalans—Dr. B. H. Paul—has since communicated his results. He took away with him seven samples, one of the fruits or myrobalans

* This gentleman's imagination was stronger than his sense of fact.—[Ed.]

of *Terminalia Arjuna;* two of those of *T. belerica;* three of those of the true myrobalans, *viz.*, *T. Chebula;* and one of those of *T. tomentosa.* The following are his results :—

No. 1.—*T. Arjuna,*	...	1·38	per cent. of	gallo-tannic acid.
No. 4.—*T. belerica,*	...	5·03	,,	,, ,,
No. 5.— ,,	...	6·70	,,	,, ,,
No. 2.—*T. Chebula,*	...	32·82	,,	,, ,,
No. 3.— ,,	...	6·11	,,	,, ,,
No. 6.— ,,	...	26·81	,,	,, ,,
No. 7.—*T. tomentosa,*	...	5·97	,,	,, ,,

These results reveal one or two very important points. It would be hopeless in the future to take *T. Arjuna* into consideration as a tanning material. *T. belerica* and *T. tomentosa* are about equal in value ; but each contains only one-fifth of the tanning principle of the chebulic or true myrobalan. (*Compare, however, with the further remarks regarding* Professor Hommel's *analysis*, p. 89.) But of the three samples of true myrobalans furnished to Dr. Paul, one contained only about the same proportion of gallo-tannic acid as is usually found in the beleric myrobalan.* The writer gave the above samples to Dr. Paul personally ; and, together with the report, received back one fruit, with its number written on it. The record of despatch of samples agreed with the return ; so that no room for doubt remained as to the botanical identification being correct. Moreover, those present at the Conference condemned the sample No. 3 as a very inferior quality of the true myrobalan. Others received corresponding samples, and their reports, had they been received, would have been most valuable as placing this matter beyond the possibility of doubt. Dr. Paul's analysis, however, of Nos. 2, 3, and 6 so completely confirm the observations and valuations made by the experts present at the Conference, that the theory then advanced regarding the superior quality of the oblong-pointed and solid fruits, as compared with the round inflated ones, will most probably be found correct, *viz.*, that the myrobalans picked off the same individual tree during different stages of their growth will be found to have a varying composition of from 6 to 30 per cent. of gallo-tannic acid. And this theory is supported by a volume of evidence in the history of all fruits, and particularly by Professor Hummel's observation (see

* May not this fruit have been one of the round spongy-textured kind; in other words, a beleric myrobalan ?—[Ed.]

a *further paragraph*, p. 91, p. 93), that the tannic principle resides chiefly in the outer pulp of the myrobalan. The transformation from the bitter unripe apple to the ripe, sweetly-flavoured fruit, is so well known as to scarcely require mention. This being so, it would seem desirable to institute a thorough enquiry into the subject of these valuable tanning materials which would have two objects in view—(*a*) to determine the exact age in each locality when the maximum amount of tannic acid was present, and (*b*) the properties and value of the fruits of one district as compared with those of another. In a country with so many different climatic features and such widely diversified peculiarities of soil as India, it neither follows that the fruits will reach their perfection at the same time, nor that different climates and soils will even, when this point has been determined, produce fruits of equal merit. Were these questions determined, it would be possible for Government to encourage, with reasonable hope of success, the development of a large myrobalan trade, and for merchants to depend upon a good supply of superior fruits. As matters stand, no dependence can be put on the supply or the quality of Indian myrobalans. In the trade a form of the true myrobalan is known as the Jubbulpur myrobalan, and this may literally be grown at Jubbulpur, or may be but a form or condition of maturity first sent to Europe from that district—that quality continuing to bear the name in spite of the fact that it may be obtained from many other localities. So very much superior are these oblong-pointed solid and pale green fruits to the large rounded samples, that several of the experts seemed to feel hurt that their belief should be questioned that these were not the fruits of a different species.

As stated above, selections of tanning materials were also furnished to Professor J. J. Hummel, Director of the Dyeing Department of the Yorkshire College, Leeds, and to Dr. Edmund Knecht, Professor of Chemistry and Dyeing at the Bradford Technical College. Professor Hummel has furnished the report below on certain of the tans supplied to him, which, besides giving the analysis of some materials that have not hitherto been subjected to chemical tests, contains many valuable and practical suggestions. In the concluding table of his Report will be found the analysis, together with a comparison in point of composition and price of the Indian tans with four standard tans at present sold in the English market. It will be observed that No. 2 was a sample of *Terminalia Chebula* (similar to that furnished as No. 2 in Dr. Paul's set); No. 5 was *T. belerica*, which gave the remarkable yield

of 17·4 per cent. of tannic acid; and No. 11, *T. tomentosa*. Consignments of most of the myrobalans were received from a great many districts in India; and it is strikingly corroborative of what has already been said regarding the necessity of a thorough investigation into the effects of climate, soil, and age of fruit, that, while Dr. Paul's sample of *T. belerica* gave only 5·03 per cent. Professor Hummel's yielded 17·4 per cent. of tannic acid. On the other hand, the Professor's sample of *T. tomentosa* afforded a little less tannic acid than that obtained by Dr. Paul. It therefore seems conclusive that Dr. Paul's sample of *T. belerica* was either obtained from a district where the species does not produce a good quality of fruit, or that the examples analysed by him were in a different stage of maturity from those examined by the Professor. So extremely satisfactory, however, are the results of these chemical tests of the Indian myrobalans, that it is difficult to dismiss the subject. The eminently practical nature of Professor Hummel's brief report affords commercial men the means of judging to what extent India might enter into competition with Ceylon and the other countries from which Europe draws its supplies instead of annually importing large quantities to meet its own market. Professor Hummel's remark regarding the prejudices of the tanning trade is important to India. He says: "In making the comparison, the first difficulty met with is that in respect of the tannic matters in use, the price and percentage of tannic acid bear no relationship whatever to each other." The prejudice in favour of certain articles, or for a peculiar colour of a material in opposition to chemical tests, is remarkable. But there is no doubt that this is rapidly disappearing; and when it is known that independent professional opinions have been given regarding an accidental series of consignments of Indian myrobalans, the one yielding 32·8 per cent. and the other 31·0 per cent. as compared with 19·5 per cent. for the myrobalans met with in European trade, an increased demand will set in for Indian tans that will stimulate the investigation indicated in this note and lead to valuable results—results calculated to benefit the inhabitants of large tracts of this country that now stand greatly in need of some additional source of revenue.

But we must allow Professor Hummel's report to speak for itself:—"Herewith I send you the results of the analysis of the various Indian tannin matters, also of some tannin matters at present used here by dyers and tanners, in order that you may have an idea of the value of the former. In making the comparison, the first difficulty met with is that, in respect of the tannin matters in

use, the price and the percentage of tannic acid bear no relationship whatever to each other. Why this is so, I am unable satisfactorily to explain ; but I imagine that it partly arises from the fact that dyers and tanners do not, as a rule, test their tannin matters, and are frequently guided in their choice by prejudices, and then the price is regulated by the demand and the supply. You will notice, for example, that ground *Sumach* is the most expensive tannin matter ; and I believe it is so, not because of its intrinsic merits, but because it is the oldest tannin matter used ; and the dyers, being very conservative, cling to its use, and are even willing to pay the higher price demanded to satisfy their whim. The supply of *Sumach* from the usual sources is limited : the demand through the conservatism of the dyers is large, and so the price is high.

" If decoctions only were used, the *divi-divi* would be the cheapest and best tannin matter to use, and *divi-divi* extract is indeed used in moderate quantity. As a rule, however, dyers and tanners prefer to make their own decoctions with the ground tannin matter, introducing the textile fabrics or skins into the muddy liquid. For this mode of working the dark outer skin of the *divi-divi* pod is objectionable, since it attaches itself to the fabric, &c., in minute particles and causes spots or stains. My results accord entirely with those given in Crooke's *Hand-book of Dyeing* and *Calico-printing*, see p. 500.

" Ground myrobalans are becoming more and more a favourite tannin matter ; and since it combines practically every desirable excellence, I recommend you to adopt it as the standard for comparison. You may consider then that the figures in the last column (under the head of ground myrobalans) represent the present market values of the various Indian tannin matters. In the case, however, of those whose decoctions possess a deep reddish color, the price would on that account have to be somewhat lower still.

" On examining the list, it becomes evident that the best Indian tannin matters are already in the market, with the exception of *Woodfordia floribunda ;* and even this has the drawback of giving deeply colored decoctions.

(*To be continued*).

III NOTES, QUERIES AND EXTRACTS.

FORESTRY IN THE COLONIES AND IN INDIA.

(*Continued from page 329*).

II.—FORESTRY IN AUSTRALIA.

AUSTRALASIA includes nine British Colonies, of which five (New South Wales, Victoria, Queensland, South Australia, and Western Australia) form the mainland, or Australia proper. Tasmania, New Zealand, and the Fiji group form separate islands, and New Guinea part of one.

The Australian main land lies between the 10th and 39th degrees of southern latitude, so that nearly half of it is comprised within the tropics. Tasmania is situated between the 41st and 44th, and New Zealand between the 34th and 47th degrees of southern latitude.

The population and areas of the seven principal Colonies at the end of 1888 are shown by the Statistical Abstract to have been as follows:—

Colony.	Area in Square Miles.	Population. Total.	Population. Square Mile.
New South Wales, ...	311,098	1,085,739	3
Victoria, ...	87,884	1,090,869	13
Queensland, ...	668,497	387,463	·6
South Australia, ...	903,690	318,308	·4
Western Australia, ...	1,060,000	42,137	·04
Total Australia, ...	3,031,169	2,924,516	1
Tasmania, ...	26,215	146,139	6
New Zealand, ...	104,458	607,380	6
Grand Total, ...	3,161,842	3,678,035	1*

These figures show that the area is about three times that of British India, while the population amounts to about one-sixtieth,

* Exclusive of Aborigines.

hence the density of population is only about one two-hundredth part of that of India. On the other hand, Australia is inhabited by the British race. Here, then, we have to do with entirely different conditions.

The topography of the Australian Continent may be shortly indicated as follows :—The centre forms a plain consisting of a concave table composed principally of sandstone, and extending over an area of about one and a half millions of square miles. This plain is surrounded by higher ground along the coast. Along its southern margin walls of sandstone cliffs extend a great part of the sea coast ; on the east, south-east, west, and parts of the north it is bordered by terraced ramparts of mountains rising to 3,000 feet on the west coast and to 7,000 on the east coast. Along the latter a succession of mountain ranges occurs, from Portland, in Victoria, to Cape York, in the extreme north. These cordilleras are called in different parts the Australian Grampians, the Australian Alps, the Blue Mountains, the Liverpool Range, &c. Their average height has been estimated at 1,500 feet above the sea. The rivers which flow from these ranges towards the east have but short courses : those flowing towards the west or south-west have long courses. The Murray River, for instance, has a length of some 1,300 miles, draining, with its tributaries, an area of about half a million of square miles, and finding its way into Encounter Bay, in South Australia.

The causes which determine the climate of Australia are remarkable in many ways. In the first place, the northern parts of the country are situated in a tropical and the southern parts in a temperate latitude. Secondly, between the two stretches the enormous central plain, which is girded by hill ranges in most of the coast districts. The central plain is daily heated in summer to a very high degree, the air expands, is lifted, and flows away on all sides, causing an indraught of moist sea air. This is forced to rise on reaching the high coast lands, which it moistens in various degrees. Owing, however, to the great distance from the shore to the centre of the country, the latter profits only at irregular intervals by this, because the indraught is regularly stopped by the nightly radiation of the heat absorbed during the day, or the clouds are once more converted into vapour owing to the high temperature of the air. Such is the heat in the interior during the summer that the air, if it moves at all, feels like a furnace blast. Sometimes, however, sufficient masses of clouds succeed in passing over the coast ranges, and, in such cases, floods of rain fall upon the inland country. The distribution of the rain differs

considerably. The north coast has the advantage that the air drawn in from that side comes from the equatorial regions, the great reservoir of moisture. Then the hills on the east coast are comparatively high, those on the west coast are lower, and along a portion of the south there are no mountain ranges at all. Thus it happens that the rainfall at the head of Spencer's Gulf is only 6 to 8 inches; at Adelaide, 20; Melbourne, 26; Portland, 32; Sydney, 48; Newcastle, 44; Brisbane, 49; and at Rockingham Bay something like 90. Perth, again, has a rainfall of 33 inches. In every part, however, the rainfall decreases rapidly in passing inland, so that comparatively little falls on the inner slopes of the coast ranges.

The temperature depends on the situation and the rainfall. The northern part of the continent is tropical. Brisbane has a mean annual temperature of 69° Fahr., Sydney 63°, Melbourne 57°, Adelaide 65°, and Perth 64°. The mean temperature in the interior is much higher than along the shore; it is said to rise as high as 130° in the shade during summer.

I am not in a position to show in detail in how far Australia requires forests on account of their indirect effects; but, guided by a general review of the topography and climate, so far as they are known, I should say that the mainland, at any rate, should not be without forests. This view, I find, is shared by local authorities on such questions. Amongst others, Mr. John Ednie Brown, the Conservator of Forests in South Australia, in his treatise on "Tree Culture in South Australia," urged the importance of extensive forests, on account of their action in giving shelter to adjoining fields against hot or raw winds, the improvement of the soil in consequence of the formation of humus, reduction of evaporation from the soil, prevention, or, at any rate, reduction of destructive floods, augmentation and equalisation of rainfall, improvement of arid tracts, increase of the humidity of the climate, improvement of the landscape, and in many cases of the healthiness of certain tracts. Whether the increase in the total rainfall will be considerable, or even appreciable, may be doubtful, but in most other respects I have no doubt that a certain forest area, suitably distributed, would beneficially affect the country.

As regards the direct effects of forests, a strong case can be made out. The population of the continent is as yet small, being one per square mile, and yet the imports of timber have already assumed considerable proportions, as will be seen from the subjoined data, which have been taken from the Statistical Abstracts for the years 1884-88:—

	£
New South Wales, annual imports, ...	446,943
Victoria, ...	968,946
South Australia, ...	160,015
Total imports, ...	1,575,904
Queensland, annual exports, ...	12,235
Western Australia, say, ...	78,000*
Total exports, ...	90,235
Net imports, ...	1,485,669

On the whole, then, the net imports into Australia amounted to roughly, one and a half million pounds sterling a year.

Only New South Wales has, it appears, extensive coal fields which supply the Colony, and from which certain quantities of coal are exported to other parts of Australia and elsewhere. That coal, however, can only reach the localities which are within an easy distance of water and railway carriage, while all the rest of the country must rely now, and for many years to come, on fuel produced in the locality where it is wanted.

Under these circumstances, it may well be asked, how will matters stand some years hence, when the population has further increased? The increase, not only in population, but in the number of cattle, in cultivation, railway and telegraph lines, has been quite marvellous of late years, as the following data will show :—

DEVELOPMENT OF AUSTRALIA DURING 15 YEARS.

	Number in 1874.	Number in 1888.	Increase per cent. during 15 years.
Population (approximate),	1,800,000	2,925,000	62
Horses, ...	754,000	1,268,000	68
Horned Cattle, ...	5,658,000	8,134,000	44
Sheep, ...	48,097,000	79,575,000	65
	Miles.	Miles.	
Railways, ...	1,527	8,292	443
Telegraph Lines, ...	15,330	32,521	112
	Acres.	Acres.	
Land under wheat, barley, oats, maize, potatoes, and the vine, ...	1,779,000	4,184,000	135

An important question is whether the increase is likely to continue. I confess that I find considerable difficulty in answering it,

* This is the figure for the year 1886 only.

being personally unacquainted with the country. From the information at my disposal, especially that which Mr. Robert Barr Smith has kindly furnished to me, I calculate that in 1888 not more than one-third of the total area, or, say, 1,000,000 square miles, was put to profitable use, so that two-thirds, or about 2,000,000 remained available. The former, no doubt, includes most of the districts on the east, south, and west coasts, leaving the greater part of the dry interior and of the north-coast districts for further extension; hence it would appear that the increase of sheep cannot go on much longer at the same rate as hitherto. There is, however, no reason why it should not continue for many years to come at a somewhat slower rate than of late years. The area under cultivation amounts at present only to ¼ per cent. of the total area. It has increased by 135 per cent. during the last fifteen years, and is capable of an enormous further extension—a matter which depends on the increase in population. On the whole, there seems no doubt that the demand for forest produce will rise considerably. Even now the railways alone require annually about 1,600,000 sleepers. Then timber is required in large quantities for building; enormous quantities are wanted every year for fencing cultivated lands and grazing areas, for mining operations, telegraph lines, &c. As to estimating these quantities, as well as the necessary fuel, that is quite beyond my means.

I understand complaints have already been made that in many parts of the country the material for fencing is no longer available, and this difficulty will increase with every succeeding year. Let us, therefore, inquire what the existing resources are, and what the several Governments have done up to date to husband and increase them. With this view, I propose to look in somewhat greater detail at the three Colonies which already import timber on a considerable scale—South Australia, New South Wales, and Victoria.

(*a*). South Australia.

I shall commence with this Colony, because it was perhaps first in the field to introduce a separate forest law.

South Australia occupies the centre of the Australian continent, and extends from its southern to the northern coast. According to Dr. Schomburgk, Director of the Botanical Gardens at Adelaide, it may be divided into the following four regions :—

(1). The forest land region.
(2). The scrub land region.
(3). The grass land region.
(4). The intra-tropical region.

The region of the forest land occupies mostly the mountainous districts and the bases of the mountain chains. The forests are of moderate extent and rather open ; the eucalypts are the prevailing trees.

The scrub lands are found over the whole Colony, occupying perhaps one-eighth of its area. They form long stretches of desolate arid plain, the soil being comparatively poor ; there is no water ; the vegetation is stunted.

The grass lands form the principal part of the area, consisting of enormous undulating plains ; within a certain distance from the sea-shore they have been mostly converted into agricultural districts. In the interior, the fertile spots of grass land alternate with bare sandstone ridges, or rolling sand hills.

The intra-tropical region shows near the sea mangrove forests ; further inland, where the ground rises, palms appear, with various tropical timber trees, also eucalypts and acacias.

I have not come across any definite estimate of the area still under forest in this Colony. Whatever it may be, there can be no doubt that it was very much greater in former times. The settler has proved a destructive agent in this respect by clearing lands for cultivation, ring-barking trees to produce pasture lands, and by firing the bush. In all such cases a comparatively small quantity of timber was put to useful purposes, while the bulk of the material, which had taken long periods to ripen, was ruthlessly destroyed by fire, or allowed to rot, so as to get rid of it. The result is that the area now under forest is not sufficient to meet the requirements of the country, and will fall more and more short of actual wants, in the same degree as the population increases. This has been felt for some years past, and various measures have been taken and laws passed for the preservation of the forests.

The ball was set rolling, it appears, by Mr. Krichauff, M.P., who, in 1871, called for a return showing the state of supply of forest produce and the preservation and culture of forests. The result of this inquiry was an Act passed in 1873, dealing with the encouragement of tree-planting. In 1875 a Forest Board was established by Act of Parliament, and then followed various amending Acts. About the year 1877 a Conservator of Forests was sanctioned, to which post Mr. John Ednie Brown was appointed in 1878.

In 1882 a new Act was passed, called "The Woods and Forests Act, 1882," which is divided into six parts, dealing with the following matters :—

PART I. repeals the previous forest law and abolishes the Forest Board.